University of Saskatchewan
EP 155 – Electric and Magnetic Circuits
Midterm Examination #2

Time : 7:00-8:30 p.m. March 19, 2003.

Student's Name : (Print) _____

Student's Number: _____

Section (please circle): **Section 2** (1:00-2:30 pm) **Section 4** (2:30-4:00 pm)

Note : ***The constant k in Coulomb's Law is $9x10^9$ N m^2/Coulomb^2***

Please report the final answers in the boxes provided.

Please show your work to convince the markers that you understand the material. Work written on the back of any page will ***NOT*** be marked.

The value for each partial question is indicated in parentheses.

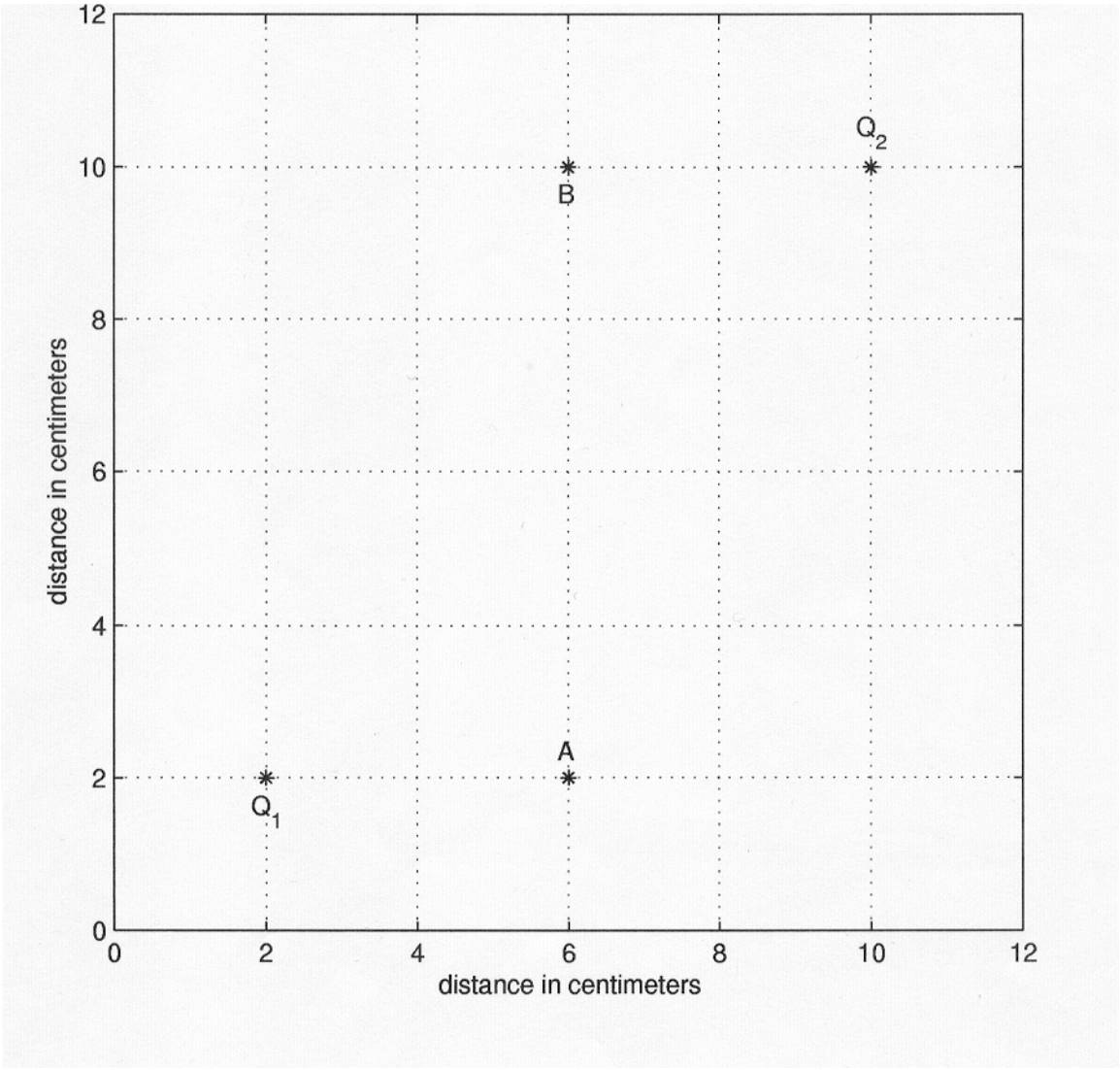
Marks for the exam (do not write in this space):

Q1:	Q4:
Q2:	Q5:
Q3:	Q6:
	Total:

Problem 1. Figure 1 shows the location of two positively charged particles, Q_1 and Q_2. The particle denoted Q_1 has a positive charge of 10 nC and the particle denoted Q_2 has a positive charge of 5 nC. The two particles have (x,y) coordinates (2,2) and (10,10) respectively, where each coordinate has units centimeters.

a) How much work is required to move a test charge of 2 mC from point A to point B [point A has coordinates (6,2) and point B has coordinates (6,10)]? **(3 marks)**

b) What is V_{BA} ? **(3 marks)**



Problem 2. Consider the circuit shown in Figure 2:

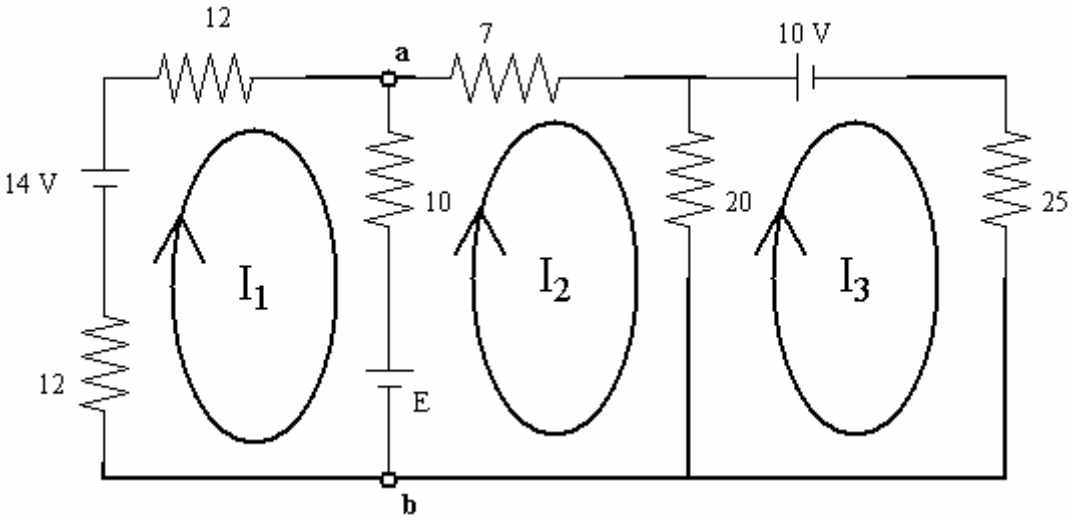


Figure 2 (all resistances are in Ohms)

Given $\mathbf{I_1 = 0.323\ A}$ and $\mathbf{I_2 = 0.099\ A}$:

i) What is the voltage across the **10 Ω** resistor? **(3 marks)**
ii) What is the voltage $\mathbf{V_{ab}}$? **(3 marks)**
iii) What is the current $\mathbf{I_3}$? **(3 marks)**
iv) What is power dissipated in the **10 Ω** resistor? **(3 marks)**
v) Write the loop equations for the circuit shown in Figure 2. Use the matrix template given below. **(3 marks)**

$V_{10\Omega}$ =	I_3 =
V_{ab} =	$Power_{10\Omega}$ =
Equations	

$$\begin{pmatrix} & & \\ & & \\ & & \end{pmatrix}\begin{pmatrix} I_1 \\ I_2 \\ I_3 \end{pmatrix} = \begin{pmatrix} \\ \\ \end{pmatrix}$$

Problem 3.

a) Write the nodal equations for the circuit shown in Figure 3. Use the matrix template given below. **(3 marks)**
b) Solve for the voltages V_1 and V_2. **(3 marks)**
c) Find the magnitude and direction of the current through the 3-Ω resistor. **(3 marks)**
d) Find the magnitude and direction of the current through the 6-Ω resistor. **(3 marks)**

V_1=	$I_{3\Omega}$=	Direction of $I_{3\Omega}$ Circle the correct answer Left Right
V_2=	$I_{6\Omega}$=	Direction of $I_{6\Omega}$ Circle the correct answer Left Right

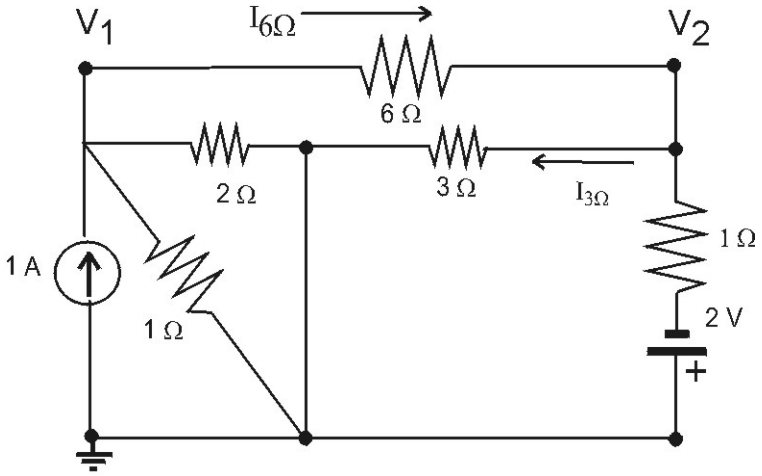


Figure 3.

$$\begin{pmatrix} & \\ & \end{pmatrix}\begin{pmatrix} V_1 \\ V_2 \end{pmatrix} = \begin{pmatrix} & \\ & \end{pmatrix}$$

Problem 4. Using superposition (Figure 4), find

a) the current through the 2-Ω resistor due to the voltage source. **(3 marks)**
b) the current through the 2-Ω resistor due to the current source. **(3 marks)**
c) the power dissipated by the 2-Ω resistor. **(3 marks)**

$I_{2\Omega}$(volt.source) =	$I_{2\Omega}$(curr.source) =	$P_{2\Omega}$ =

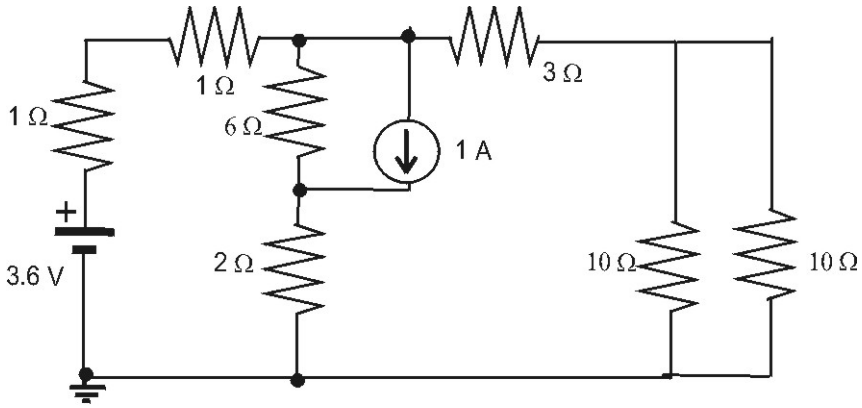
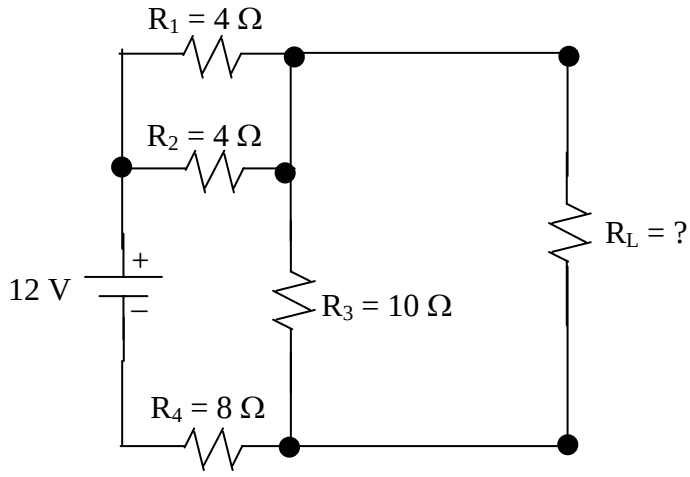


Figure 4.

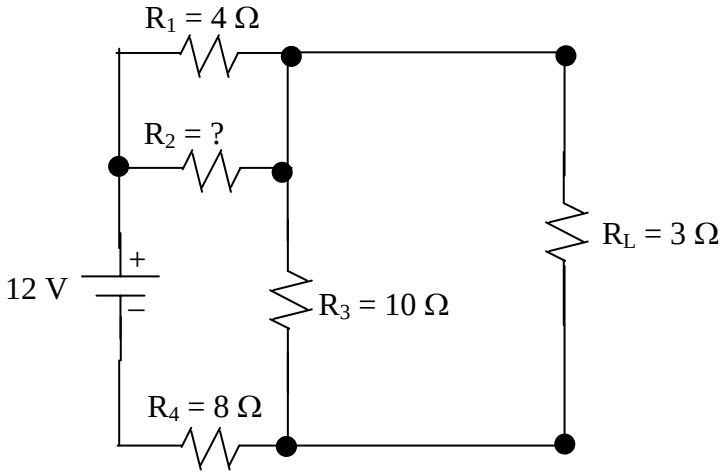
Problem 5. In the circuits shown below, the objective is to achieve maximum power dissipation by the load resistor R_L in ***each*** case.

Part a R_L =	Part b R_2 =

(a) What is the value of R_L for maximum power dissipation by R_L? **(3 marks)**



(b) What is the value of R_2 if there is maximum power dissipation by R_L? **(3 marks)**



Problem 6.

i. Determine the Thévenin equivalent circuit between terminals “a” and “b” for the circuit shown below, *i.e.* what is R_{Th} and E_{Th}? **(6 marks)**

ii. Draw the Thévenin equivalent circuit, you are to clearly indicate the polarity of the battery and the terminals “a” and “b”. **(3 marks)**

R_{Th} =	E_{Th} =
Thévenin circuit